

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

(1) Application No. 41988/73 (22) Filed 6 Sept. 1973 (19)  
 (31) Convention Application No. 41355/72 (32) Filed 7 Sept. 1972 in  
 (33) Sweden (SW)  
 (44) Complete Specification published 26 May 1975  
 (51) INT. CL.<sup>2</sup> F16L 9/18  
 (51) Index at acceptance

F2P 1A34 1B2 1B7 2A5 3  
 (72) Inventor LENNART ERIK ELOF JANSSON



## (54) A METHOD OF LINING PIPES

(71) We, STABILATOR AB, a Swedish Body Corporate, of Brommapian, S-161 47 Bromma, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of lining pipes, for example, pipes made of concrete and which have been laid in the ground, in which a flexible tube or hose having a surface diameter corresponding to the inner diameter of the pipe to be lined is placed in said pipe, said flexible tube being radially contracted before being placed in the pipe so that the greatest width of the tube is less than the inner diameter of the pipe and at least one inwardly folded section of the tube exists which forms a groove in the body surface of the tube and extends axially along the tube.

It has been proposed to line pipes by this method, for instance by holding a flexible tube in a contracted state by a plurality of steel bands which are arranged around the periphery of the tube, said steel bands being provided with releasable locking means. By releasing all the locking means simultaneously, the bands release their hold on the tube so that the tube can return to its original shape. The release is obtained with the help of a wire to which is applied a drawing force, said wire being connected to all of the locking means.

However, the use of steel bands to contract the flexible tube involves a significant disadvantage. Outside of the fact that the construction is expensive, it also uses up space, as the locking means uses up a certain radial space, with the result that, after release, the flexible tube does not lie against the inner wall of the pipe in the space taken up by the locking means. Problems also arise when the flexible tube is fed into the pipe due to friction between the steel bands and especially the locking mean and the often rough and uneven inner wall of the pipe. It has also been found to be difficult to release the locking means without first

having provided a device to allow a drawing force to be provided in both directions, that is, opposing drawing forces must be provided on both of the band sections which form the locking means.

The aim of the present invention is to provide a method which at least reduces the disadvantages described above.

According to the present invention there is provided a method of lining pipes, for example pipes made of concrete which have been laid in the ground, in which a flexible tube or hose having an outer diameter corresponding to the inner diameter of the pipe, said flexible tube, before being inserted into the pipe, being radially contracted so that the greatest width of the tube is less than the inner diameter of the pipe and at least one radially inwardly folded section exists which forms a groove in the body surface of the tube and extends radially along said tube, and the tube being held in said contracted state by wires or bands which are spaced along the length of the tube and arranged around the periphery of said tube, and wherein, after the flexible tube has been inserted into the pipe, the wires or bands are cut or ruptured in order to release their hold on the flexible tube.

The bands which can be non-metallic, are adhesive and composed of a plastics material. As such they are very easy to mount and can be made very thin while having the necessary strength. The friction between the contracted flexible tube and the pipe is thereby significantly reduced during the insertion of the flexible tube.

According to a preferred embodiment, the wires or bands are cut by a knife arrangement which, using the groove for guiding purposes, is moved from one end of the flexible tube to the other.

The method according to the invention is now described by way of example only, with reference to the enclosed drawing in which the Figure shows a cross-section of a concrete pipe having a flexible tube inserted in a contracted state.

In the Figure, the pipe which is to be lined is referred to as 1. A flexible tube 2, preferably of a plastics material or another suitable material, for example nylon or rubber, is inserted in the pipe 1. The plastics tube 2 is shown in the contracted state, that is it is folded so that a groove 3, running in the axial direction of the tube 2 and having a U-shaped cross-section, is formed in the body surface of the tube 2. In this manner a reduction of the diameter of the flexible tube 2 is obtained in relation to the original diameter of said flexible tube 2 and against the corresponding inner diameter of the pipe 1 so that the plastics tube 2 can be easily inserted in the pipe, even in longer lengths. In order to facilitate the contraction of the plastics tube 2, it is possible to form said tube with somewhat thinner wall thicknesses in those sections 4 which are folded during contraction, and forming of the U-shaped section 3.

The plastics tube 2 is held in a contracted state with the help of a plurality of wires or bands 5 of a suitable material and which are evenly spaced along the length of the flexible tube 2. The bands or wires 5 are of the necessary strength and can be cut off by a knife arrangement or ruptured. Adhesive bands 5 of a plastics material are preferably used, which can be easily mounted on the flexible tube 2 without special measures being necessary for connecting the ends of the bands with each other. The mounting of the bands can, by a simple method, take place by the plastics tube 2 being pressed through an opening having a diameter corresponding to the diameter of the tube 2 in a contracted state, whereon the bands 5 are successively fastened around the tube as it passes through the opening.

The bands 5 are made to release their hold on the tube 2 after the tube 2 has been inserted into the pipe 1 so that the tube can expand to its original form and lie against the inner wall of the pipe 1. In order to achieve this, the bands 5 are cut in the space 6 which bridges the groove 3 by a knife arrangement 7 which is moved in the groove from one end of the tube 2 to the opposite end of said tube.

The knife arrangement 7, the construction of which can vary within wide limits, shows in the greatly simplified embodiment shown in the Figure, a vertical knife blade 8 which extends above the band section 6. The blade 8 is fastened to a support arrangement 9 having small vertical wheels or discs 10 and horizontal wheels or discs 11 which are supported against the bottom and side walls, respectively, of the groove 3 which functions as steering means during the advancement of the knife arrangement 7 in the groove 3. In order to further secure the steering of the knife arrangement 7,

support members which are not shown in the drawing can be arranged to be supported against the bottom side and top side, respectively, of the band section 6, in the form of horizontal support surfaces which are arranged directly on the knife arrangement 7. Another possibility is to arrange a member which is directly supported against the pipe 1 above the band section 6.

Instead of a conventional knife blade 8, a heating wire which is heated by electricity can be used.

The advancement of the knife arrangement 7 is accomplished by, for example, a wire connected to said knife arrangement, said wire extending the entire length of the groove 3. When the bands 5 are to be cut off, the knife arrangement 7 is placed at one end of the groove 3 after which, by means of the wire, it is pulled over to the other end during which it successively cuts off the bands 5.

The method according to the invention has been described above with reference to an embodiment in which a knife arrangement 7 cuts off the bands or wires 5. The bands can, within the scope of the invention, be ruptured by the groove 3 or the flexible tube 2 being caused to expand so that the bands 5 are subjected to a tensile force which is sufficiently great for the bands to break.

For this purpose, a body can be used which has such a form and cross section that the groove 3 is forced to expand when the body 2 is advanced through the groove 3 from one end of the tube 2 to the opposing end. The body can, preferably, have the shape of a cone which is inserted into the tube with its pointed end first. The largest cross section of the cone shall be larger than the cross section of the groove 3. In a corresponding manner, a body can be advanced through the tube 2 itself so that the tube 2 expands. This body can also be conical, whereby the largest cross section of the cone is greater than the greatest width of the tube when the tube 2 is in a contracted state.

According to the invention, the tube can also be used to expand by both of the open ends of the tube 2 being air-tight sealed, after which the inside of the tube 2 is subjected to pressure by connection to a source 120 of compressed air.

#### WHAT WE CLAIM IS:—

1. A method of lining pipes, for example pipes made of concrete which have been laid in the ground, in which a flexible tube or hose having an outer diameter corresponding to the inner diameter of the pipe is inserted into said pipe to line the pipe, said flexible tube, before being inserted into the

pipe, being radially contracted so that the greatest width of the tube is less than the inner diameter of the pipe and at least one radially inwardly folded section exists which forms a groove in the body surface of the tube and extends axially along said tube, and the tube being held in said contracted state by wires or bands which are spaced along the length of the tube and arranged around the periphery of said tube, and wherein, after the flexible tube has been inserted into the pipe, the wires or bands are cut or ruptured in order to release their hold on the flexible tube.

15 2. A method according to claim 1, wherein the wires or bands are successively cut by means of a knife arrangement which, using the groove as a guide, is advanced from one end of the tube to the opposite

20 3. A method according to claim 1, wherein the wires or bands are successively ruptured by means of the groove or the tube being forced to expand by means of a body, preferably in the shape of a cone, the largest cross-section of which is larger than the cross-section of the groove or the tube,

and which is advanced in the groove or the tube from one end of the tube to the opposite end.

25 4. A method according to claim 1, wherein the wires or bands are ruptured by means of the two ends of the tube being sealed airtight, after which the inside of the tube is subjected to pressure by connection to a source of compressed air so that the tube is forced to expand.

30 5. A method according to any preceding claim where non-metallic bands are employed.

35 6. A method according to any preceding claim, wherein the flexible tube is held in a contracted state by means of adhesive bands composed of a plastics material and evenly spaced along the length of said tube.

40 7. A method of lining pipes substantially as described with reference to and as shown in the accompanying drawing.

30

35

40

45

J. A. KEMP & CO.,  
Chartered Patent Agents,  
14 South Square,  
Gray's Inn,  
London WC1R 5EU.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1976.  
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY  
from which copies may be obtained.

1437273

COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of  
the Original Drawing reduced scale

